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WHAT DO VOLUNTARY EXPORT RESTRAINTS DO?

Kala Krishna

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ABSTRACT

This paper has two aims. First, to examine alternative ways of modelling VERS in imperfectly competitive markets. This is important, since the effects of VERS are sensitive to the models used. Second, to argue that the effects of VERS also depend on whether goods are complements or substitutes. This point is illustrated by extending the model of Krishna (1983) to allow complementary goods to be produced by domestic and foreign firms. If goods are substitutes, VERs set at free trade levels raise all profits, while if they are complements, the VERS have no effect. Thus tarrifs and quotas are fundamentally non-equivalent under Bertrand duopoly when substitute goods are produced, but are equivalent when complementary goods are being produced. This is contrasted to the case of Stackelberg leadership. The importance of specifying the effects of any restriction on the payoff functions of agents and using this to analyze its effects on equilibrium of the game is emphasized.

Kala Krishna
Department of Economics
Harvard University
Littauer 215
Cambridge, MA 02138

1. Introduction

The post World War II era is often hailed as a period of great trade liberalization, which led to gains for all parties through free trade. Due to a series of negotiations conducted under the auspices of GATT, tariffs have been negotiated steadily downwards, until at present they are at an average level of about 4% on manufactured goods.[1] However, this figure does not necessarily indicate that protection has fallen over time. Since 1970, a new kind of protectionism involving non tariff barriers (NTB's) has arisen.

The leading instruments of this "new protectionism" have been the so-called "voluntary export restraint" or VER, and its relation, the orderly marketing arrangement (OMA). Although the articles of GATT explicitly forbid quotas since they are inherently discriminatory, the proportion of total world trade that moves under some kind of quantitative restraint is thought to be between 30 and 50%.[2]

The rise in the "new protectionism" coincided with the slow economic growth and higher unemployment of the early 1970's, and is often linked causally to the adverse economic environment faced by established industries in this period. The popularity of VERs is due to a number of legal, political and economic advantages which they have over more traditional protectionist measures. This is likely to make them even more widely advocated in the future. VERs, however, tend to be socially inefficient ways of providing protection although they do have advantages for certain groups.

There are two broad sets of reasons which are often given for why VERS are being increasingly used. The first set relates to the legal and political environment. The second set relates to the economic environment.

Consider their legal and political advantages. There are at least three such advantages.

The first one is that GATT places several restrictions on the use of the more traditional forms of protection, tariffs and quotas. Tariffs have been restricted through agreements on bindings (which are promises to bind tariffs) and through negotiated reductions in tariffs. Quotas are expressly forbidden by article XI of GATT. Thus, it is natural for substitution to occur towards other legal forms of protection such as VERs.

The second advantage of VERs compared to less discriminatory measures is that the VERS are set on particular industries and countries. Their inherently discriminatory nature allows producer and labor groups in the affected industry, who stand to gain from a VER, to easily coordinate their efforts in the hope of mutual advantage. On the other hand, consumer losses from higher prices are spread over all consumers and this makes it harder to coordinate opposition to such measures from consumers, since an individual consumer has less to lose than the interest groups in the affected industry do. As VERs on each industry are imposed in a piecemeal fashion, consumers and consumer groups are even less likely to strongly oppose each individual VER.

More important, VERs tend to circumvent the public debate which is associated with policies which have to go through Congress. Since VERs are "negotiated" between the executive branch and foreign governments who agree to enforce them, industries can, in effect, obtain VERs without prolonged public debate.[3]

Next, consider the economic advantages of VERs. The most discussed economic reason for their popularity is that VERs, unlike tariffs, offer a

bribe to the foreign producers in the form of the implicit quota rents which accrue to foreigners. This, it is felt, makes them more amenable to such arrangements. This is particularly true since the carrot of additional revenues is accompanied by the threat of tariffs. However, Tumlir (1985), for example, argues that this threat is not necessarily credible given that tariffs are hard to obtain from Congress. In addition, they are often illegal under GATT so that a presidential veto would almost certainly have to follow congressional approval. This lack of credibility is not, however, an issue if producers are better off with a VER. This is quite probable since another effect of a VER is to, in effect, legally create a cartel organized by the agency implementing the VER. This is another advantage of a VER for foreign and domestic producers, since such a cartel is likely to raise their profits.

In an imperfectly competitive market the creation of a cartel is not required for foreign firms to benefit from a VER. This is due to the fact that the VER itself alters the "game" that domestic and foreign firms play by acting as a credible constraint on the output of the foreign firm. There are two aspects to this. The first is related to the fact that a VER allows a foreign entrant in an established domestic industry to precommit to a small size. In the sequential game that follows, the entrant sets a low enough price so that the established domestic firm does not find it worthwhile to undercut the foreign firm and accommodates entry. This is an example of the "Judo economics" described by Gelman and Salop (1983).[4]

The second way in which a VER changes the "game" played by firms is that the capacity constraint on the foreign firm acts as a facilitating device making it optimal for the domestic and foreign firms to raise their prices in

equilibrium when they produce substitute goods. This gives them higher equilibrium profits. This argument is independent of the cartelization of foreign firms by the implementing authority previously mentioned. This is shown in Krishna (1983).

This paper has two aims. First, to examine alternative ways of modelling VERS in imperfectly competitive markets. This is important, since the effects of VERS are sensitive to the models used. Second, to argue that it is vital to be clear about the timing of moves by players, and to model the effects of a VER carefully. This point is illustrated by extending the model of Krishna (1983) to allow complementary goods to be produced by domestic and foreign firms. If goods are substitutes, VERs set at free trade levels raise all profits, while if they are complements, the VERS have no effect. Thus tarrifs and quotas are fundamentally non-equivalent under Bertrand duopoly when substitute goods are produced, but are equivalent when complementary goods are being produced. This is contrasted to the case of Stackelberg leadership. The importance of specifying the effects of <u>any</u> restriction on the payoff functions of agents and using this to analyze its effects on equilibrium of the game is emphasized. The next section briefly surveys some of the work in this area.

2. Approaches to the Analysis of VERs

The analysis of voluntary export restrictions (VERs) has attracted much attention since the imposition of VERs on the import of Japanese automobiles to the United States in 1981. A number of different approaches have been taken to modeling their effects in imperfectly competitive markets, at both a theoretical and empirical level. The classic work of Bhagwati (1965) on the non-equivalence of tariffs and quotas in the presence of a domestic monopoly is the starting point of much of this work.

The approaches used to analyze the effects of VERs vary from static oligopoly models to dynamic repeated game models. Static models tend to give more clear cut empirically testable results than dynamic ones. This is both because of the normal multiplicity of equilibria which arise in dynamic models, and because the more varied effects which occur in such models can offset each other. Ultimately, the choice of modeling strategy should, of course, be guided by the empirical validity of its predictions. For this reason it is worthwhile focusing on the empirically testable implications of a given modeling technique.

I will focus on static models in this paper and argue that it is important to model carefully the effects of a VER upon the game played by the firms. This is particularly so when neither the domestic nor the foreign firm is a Stackelberg leader. Recent work by Harris (1985) and Itoh and Ono (1984) does not adequately model this case. As a consequence, their results differ from those obtained when the effects of a VER on the profit function of the firms, and hence on the game itself, are more carefully analyzed as in Krishna (1983). I will first discuss how the work of Harris (1985) and Itoh and Ono

(1984) relates to my work, and then briefly survey other recent work in the area which is less closely related to this paper.

Itoh and Ono (1984) analyze the effects of a VER in an oligopoly model with one foreign and one domestic firm. Firms are assumed to compete in price and to produce differentiated substitute products. They argue that tariffs and quotas are equivalent in such a model. However, Itoh and Ono's results hold only when excess demand for the foreign good has no effect on the demand for the domestic good. Since the goods are substitutes, this is hard to justify. When the game is carefully modelled, as in Krishna (1983), it is clear that VERs have effects by their very existence and that this makes tariffs and quotas fundamentally non-equivalent when foreign and domestic goods are substitutes.

Harris (1985) argues that VERs are truly voluntary since they raise profits of all firms. However, he does not model the effects of the VER on the profit functions of both firms and hence on the game itself in a careful way. Rather, he assumes that a VER makes the domestic firm into a Stackelberg leader. Krishna (1983) does not make this assumption, but proves that in the unique mixed strategy equilibrium the domestic firm earns the same profits as a Stackelberg leader when a particular rationing rule is used. Both papers deal only with the case when the products of the two firms are substitutes. In this paper I show that when the products produced by the two firms are complementary, the VER has no effect on equilibrium and does not even give the domestic firm the profits of a Stackelberg leader.

The essence of the argument that the game itself changes due to a VER can be understood by realizing that there are three effects of a VER in

oligopolistic markets. I call these the "competitive", "monopoly" and "interactive" effects.

The "competitive" or "C" effect is the only one that operates in competitive environments. In a competitive framework, a VER works by altering market demand and/or supply functions wherever the constraint is binding. If the VER is set at the free trade level of imports it will have no effect, since such policies only affect equilibrium in competitive markets by being set at restrictive levels.

With domestic monopoly and foreign competition, even VERs set at free trade levels have effects. These arise because VERs alter demand and/or supply conditions at points other than the unconstrained equilibrium point and so affect the decision of the domestic monopolist. In this manner restrictions can have significant effects by their very presence. This point was made by Bhagwati (1965). I call this the monopoly or "M" effect and it operates in addition to any "C" effect that may occur.

In an oligopoly model not only do the effects present under monopoly occur, but because each agent can be affected in the same manner as the monopolist, and the actions of all agents are interdependent, an additional effect, which I call the interactive or "I" effect, arises.

In the analysis of VERs with differentiated products, when firms compete in price and produce substitute goods, the imposition of a VER on the foreign firm makes the domestic firm's demand function less elastic for price <u>increases</u>. This makes it profitable for the domestic firm to raise its price at what would be the free trade equilibrium. This is the "M" effect. The increase in the domestic firm's price makes the constraint bind on the foreign

firm and makes it optimal for it to also raise its price since it is effectively supply constrained. This is the essence of the "I" effect.

Both "I" and "M" effects raise domestic profits when the goods are substitutes. Moreover, as long as foreign supply is not constrained too far below the free trade level, foreign profits also rise along with prices. This is basically the argument in Krishna (1983) about how VERs facilitate collusion with substitute goods. The equilibrium with a VER is shown to be a mixed strategy one which gives the domestic firm the profits of a Stackelberg leader when a particular rationing rule is used, and raises profits both at home and abroad.

Since Harris (1985) assumes that a VER makes the domestic firm into a Stackelberg leader, his results on profits are similar to the above when goods are substitutes. However, when complementary products are considered, there are no "M" and therefore no "I" effects, as is shown below. Thus, with complementary products, tariffs and quotas are equivalent even with Bertrand duopoly. This is not the result obtained by assuming that a VER makes the domestic firm into a Stackelberg leader.

There has been a good deal of work on the effects of VERs in other market structures, and using other strategic variables. I briefly review some of this literature in order to relate the results to those of this paper.[5]

Work has focused on the effects of VERs in Stackelberg leadership models, Cournot models, repeated game models, and on the quality change effects of quotas. The models traditionally used are duopoly or monopoly models since they are the simplest ones in which such issues can be adressed.

Stackelberg leadership models show that quotas are not in general equivalent to a tariff in such a setting and that a VER may have effects even

when set at free trade levels. Moreover, these models show that the endogenous determination of a Stackelberg leader tends to work in favor of the home firm being the leader. The work of Itoh and Ono (1982), (1984) addresses such issues. However, it is not clear why one should expect one or the other firm to have a first mover advantage and it is desirable to consider models without this requirement.

The effect of a VER and the equivalence/non-equivalence of tariffs and quotas when neither firm is a Stackelberg leader and firms compete in quantity á la Cournot is elementary. When quantity is the strategic varible, tariffs and quotas are obviously equivalent and a VER at the free trade level has no effect.

Although both price and quantity competition models (and their variants) are widely used, it is a bit unsatisfactory to use Cournot models in analyzing quantity constraints, since quantity constraints restrict the strategic variable itself and leave no room for firms to change their strategic behavior endogenously. This is the main reason in favor of using price setting models in the analysis of VERs. The sensitivity to the strategic variable used of the results of trade restrictions in oligopoly models has been analyzed in Eaton and Grossman (1986).[6]

The effects of VERs have also been studied in the context of repeated games. Their effects in such models are harder to predict, since a VER reduces the profitability of deviations from a collusive outcome but also curtails the ability to punish such deviations. In addition, the usual problems in such games of having too many equilibria also arise. Davidson (1984) deals with the effects of tariffs while Rotemberg and Saloner (1986)

deal with quotas. Lambson and Richardson (1986) deal with the effects of quotas in such models, both from a theoretical and empirical point of view.

In the long run, firms could choose to modify product type as well as price in response to a VER. This is studied for monopoly and competitive situations by Rodriguez (1979), Santoni and Van Cott (1980), Das and Donnenfeld (1984), Falvey (1979) and Krishna (1984,1987). Das and Donnenfeld (1985) also analyze the effects of trade restrictions with a special duopoly model of vertical product differentiation. However, to the extent that product adjustment takes longer than price adjustment, models focusing on the short run effects of trade restrictions can safely neglect such effects.

A good deal of empirical work has also been evident in this area. In particular the work of Feenstra (1984, 1985, 1987), who documents the rise in quality of automobile imports following the VER, and of Aw and Roberts (1986) on footwear, is worth mentioning. In addition, Dixit (1986) and Levinson (1987) is a mix of theory, simulation and empirical work in the automobile industry which seems particularly promising. While none of the empirical work explicitly tests whether the VERs on automobiles made firms behave more collusively, there are indications that they may have done so. For example, while the VERs imposed in March 1981 for March 1981-April 1984 were at 1.68 million cars per year, about 5% below the existing level of imports, the increase in the price of Japanese imports was almost 20% in the first year of the VER.[7] Levinson (1987) estimates the own elasticity of demand for Japanese imports to be around 1.57. This would seem to suggest that the VER may have had the kinds of effects suggested by the model of Krishna (1983) and that it is worth understanding such models better.

In this paper I will concentrate on the effects of a VER with complementary goods in order to focus on the difference between Harris' approach and mine. Its effects when goods are substitutes are more complex and are dealt with in Krishna (1983). The model is presented in the next section and a VER is analyzed in Section 4, as is a tariff. Tariffs and quotas are shown to be equilvalent when goods are complements, in contrast to their non-equivalence when goods are substitutes. The final section contains some concluding remarks.

3. The Model

There are two firms, domestic and foreign, producing differentiated goods in amounts x and x* respectively. Demand arises from utility maximization by an aggregate domestic consumer of u(S) + n, subject to a budget constraint. The scalar, S = F(x,x*), represents the services produced by the two goods. Services can be thought of as being produced by the aggregate consumer in which case F(.) is a household production function. Alternatively, S could be thought of as being produced by competitive suppliers of services who in turn require x and x* to make S. F is assumed to be a constant return to scale production function. n is the amount of the numeraire good consumed. As usual, the budget constraint is given by

$$P_s S + n \leq I + T,$$

where P_s is the price of a unit of services which of course depends on the prices of x and x* and the production technology. I and T denote lump sum income and any tariff revenue that arises. I and T are taken as given constants in the maximization of utility.

These assumptions give rise to a demand function for S, S^D, where

$$S^D = D(P_s).$$

Of course, $P_s = C(P,P^*)$ where C(.) is the unit cost of producing a service associated with the production function F(.) given that the prices of goods produced at home and abroad are P and P*, respectively. This is because of either competition in the market for services or because of household production of S. The demand for the home firm is therefore given by

$$x(P,P^*) = a(P/P^*)D[C(P,P^*)],$$

where $a(P/P^*) = C_p(P,P^*)$ by Shephard's lemma and is the amount of x needed to produce a unit of S at minimum cost, given the prices of x and x*. Similarly, the foreign firm's demand function is given by

$$x^*(P,P^*) = a^*(P/P^*)D[C(P,P^*)]$$

where $a^*(P/P^*) = C_{p^*}(P,P^*)$.

An increase in the price of the imported good, P*, has two effects: it raises x(.) since it raises a(P/P*), but it also reduces x(·), as it raises C(.) and hence reduces D[C(.)]. The intensity of the first effect depends positively on the elasticity of substitution between x and x* in making S. The intensity of the second effect depends on ϵ, the price elasticity of demand for S. With a constant elasticity of substitution, σ, between x and x*, goods are substitutes when $\sigma - \epsilon > 0$ and complements when $\sigma - \epsilon < 0$.[8]

I will consider the case where $\sigma - \epsilon < 0$, so that the goods are complements in demand. Firms are assumed to compete in price.[9] In order to eliminate the possibility of multimarket interactions, I assume that marginal costs of production of the two firms are constant at r and r*. The domestic firm chooses P to maximize its profits $\pi(.)$, where

$$\pi(P,P^*) = (P-r)a(P/P^*)D[C(P,P^*)].$$

It takes P* as given and chooses its optimal P for every P*, which yields its best response function B(P*). Similarly, the foreign firm's maximization of $\pi^*(P,P^*)$ defined analogously yields B*(P). The intersection of B(.) and

$B^*(.)$ gives a Nash equilibrium point. I will assume that $\pi(.)$ and $\pi^*(.)$ are concave in their own price for any given price of the other and that a unique stable Nash equilibrium exists. In order to focus on any possible effects of a VER, I will assume for simplicity that in its absence firms are identical.

Both upward and downward sloping best response functions are possible, so that no assumptions about the slopes of $B(.)$ and $B^*(.)$ are made aside from their both being of the same sign, and the system being stable. The stable equilibrium with downward sloping best response functions is depicted in Figure 1. Profits of each firm increase as the other's price decreases, as is shown by the direction of the arrows in Figure 1.

4. The Effects of Trade Restrictions

Having specified the operation of the model in the absence of trade restrictions, I turn to the effects of trade restrictions on the equilibrium of the game. I first consider the effects of VERs and then turn to the analysis of tariffs.

The first step is to identify the region of prices where the VER is binding. To do so, consider the set of prices such that the constraint on imports is exactly met. I will assume in the exposition that the VER is set at the free trade level. It will become clear that the analysis generalizes for any level of the VER in a straightforward manner.

The line $P^* = G(P)$ depicts the set of P and P* such that the demand for x* equals its level under free trade. Hence, it passes through (P_N, P_N^*), the Nash equilibrium point. As the goods are complements, G(P) is downward sloping, and the constraint binds on the foreign firm at points below the line G(P). For a given P, low values of P* raise its demand and make the constraint bind. For a given P*, low values of P raise the demand for x*, making the constraint bind.

Consider the effect of the VER on the best response function for the foreign firm. The case depicted in Figure 1 with downward sloping best responses will be analyzed. It should be obvious that similar arguments can be used to analyze upward sloping best responses. For $P < P_N$, the foreign firm would, in the absence of a VER, choose to charge a price such that its demand exceeds the level of the VER. This is evident from Figure 1 as $B^*(P)$ lies to the left of G(P) for $P < P_N$. The VER, however, forces the foreign firm to sell less than it would desire, and its optimal strategy is to sell

all that it is allowed at the price that clears the market -- i.e., at G(P).[10] For prices above P_N, B*(P) lies to the right of G(P) and the constraint does not affect the foreign firm's behavior. Thus, the foreign firm's best response function in this region is given by $\bar{B}^*(P)$ which is depicted by the dashed line in Figure 1.

Next, consider the effect of the VER on the profits of the domestic firm. Define $\bar{\pi}(P) \equiv \pi(P,G(P))$. $\bar{\pi}(.)$ gives the profits for the domestic firm along the line G(P). It is assumed that $\bar{\pi}(P)$ is concave and reaches a finite maximum at $P_S < \infty$, shown in Figures 1 and 2. $\bar{\pi}(P)$ is depicted in Figure 2.

$\pi(P,P^*)$ is also depicted in Figure 2 for a given value of P*. Notice that $\pi(P,P^*) = \bar{\pi}(P)$ when P is such that $G(P) = P^*$ -- i.e., at $P = G^{-1}(P^*)$. At this point it is easy to see that $\pi_p(P,P^*) < \bar{\pi}_p(P)$. This is because an increase in P reduces P* along G, which acts to raise $\bar{\pi}$, while no such effect operates on π.

Let $\hat{\pi}(P^*,P)$ be the profit function of the domestic firm when the VER is imposed on the foreign firm. For a given value of P*, the domestic firm can charge a low price and make the constraint bind on the foreign firm, or charge a high price and leave the foreign firm unconstrained by the VER. If the domestic firm charges a relatively low price, i.e. below $G^{-1}(P^*)$, the foreign firm is supply constrained at P* since its supply is limited by the VER and its demand exceeds this level. In this case, I assume that the following rationing rule applies: Consumers fortunate enough to obtain the foreign good at P* will resell it at a price that clears the market. Since the form of the domestic consumer utility function implies that there are no income effects, the effect on the domestic firm is exactly that of the foreign firm charging

$G(P)$ itself. However, this is exactly what $\bar{\pi}(P)$ is defined to be. Hence, if $P < G^{-1}(P^*)$, $\hat{\pi}(P,P^*) = \bar{\pi}(P)$.

If, on the other hand, the domestic firm charges a high price, i.e., $P > G^{-1}(P^*)$, the VER does not bind on the foreign firm when it charges P^* so that it is not supply-constrained and the domestic firms' profits remain $\pi(P,P^*)$. Hence, if $P \geq G^{-1}(P^*)$, $\hat{\pi}(P,P^*) = \pi(P,P^*)$.

$\hat{\pi}(.)$ is depicted in Figure 2. Notice that $\hat{\pi}(.)$ is continuous in P by definition. Since $\bar{\pi}_p(P) > \pi_p(P,P^*)$ at $P = G^{-1}(P^*)$ and $\pi(.)$ and $\bar{\pi}(.)$ are concave in P, one of the three cases must hold. Either

$$\bar{\pi}_p(.) > \pi_p(.) \geq 0, \quad \text{Case (a);}$$

$$\bar{\pi}_p(.) > 0 > \pi_p(.), \quad \text{Case (b);}$$

or $$0 \geq \pi_p(.) > \pi_p(.), \quad \text{Case (c).}$$

These three cases are depicted in Figure 2(a), (b) and (c).

Notice that even though $\hat{\pi}$ is made up of segments of π and $\bar{\pi}$, it remains concave. Thus, the best response function of the domestic firm with a VER, $\hat{B}(P^*)$, is continuous. In fact, it is easy to see what $\hat{B}(P^*)$ is from Figure 2. In Case (a), $\hat{B}(P^*) = B(P^*)$; in Case (b), $\hat{B}(P^*) = G^{-1}(P^*)$; and in Case (c), $\hat{B}(P^*) = P_S$. Also, each case is completely characterized by the slopes of π_p and $\bar{\pi}_p$ along $G(P)$. Thus in Figure 1 when $P^* > P_N^*$ the relevant case is (a). When $P_S^* < P^* < P_N^*$, it is (b) and when $P^* < P_S^*$ it is (c). This gives rise to the $\hat{B}(P^*)$ function depicted by the solid line in Figure 1.

Notice that a VER at the free trade levels has no effect on the equilibrium when goods x and x* are complements. Intuitively, this result can be explained as follows. Consider the effect of the VER on the demand for x

at (P_N, P_N^*). $x(P, P_N^*)$ is depicted in Figure 3(a). Let $\bar{x}(P)$ be the demand for the domestic product on the assumption that the foreign firm sells the exact amount of the VER which requires that $P^* = G(P)$. Hence, $\bar{x}(P) = x(P, G(P))$. $\bar{x}(P)$ is also depicted in Figure 3(a). It intersects $x(P, P_N^*)$ at $P = P_N$. It is also steeper than $x(P, P_N^*)$ at $P = P_N$ as depicted in Figure 3(a). This is because $\bar{x}_p(P_N) = x_p(P_N, G(P_N)) + x_{p^*}(P_N, G(P_N)G'(P_N))$ which exceeds $x_p(P_N, P_N)$ as $x_{p^*}(.) < 0$ and $G'(.) < 0$.

The demand function facing the domestic firm in the presence of a VER is given by the curve AEC since the VER only binds on the foreign firm when $P < P_N^*$ since the goods are complements. Although the demand function for the domestic firm on the assumption that the foreign firm sells the amount of the VER is less elastic than the demand curve facing the domestic firm when the foreign firm's price is given, the VER only restricts the foreign firm when P is low. Thus, the VER makes the demand facing the domestic firm less elastic, but only for price levels below the competitive equilibrium price. This does not create any incentive to raise or lower price on the part of the domestic firm -- i.e., no "M" effect occurs.

$x^*(P_N, P^*)$ is depicted in Figure 3(b). $\bar{x}^*$ is the demand facing the foreign firm on the assumption that the VER is binding. $\bar{x}^*$ is just the vertical line at the level of the VER. It intersects $x^*(P_N, P^*)$ at $P^* = P_N^*$. The VER is only binding when $P^* < P_N^*$. Thus, the VER makes the demand curve facing the foreign firm into A'E'C'. Hence, the foreign firm also has no reason to change its price given P_N, and the free trade equilibrium remains an equilibrium. Moreover, the VER does not give the domestic firm the profits of a Stackelberg leader.

This is in contrast to the effects of a VER with substitute goods. It is easy to see that if $\pi_{p*}(.) > 0$, as it is with substitute goods, $G(P^*)$ is upward sloping. However, even in this case, $\bar{\pi}_p$ remains greater than πp at $P = G^{-1}(P*)$. Therefore, the three cases previously mentioned remain the only ones. However, the constraint binds for <u>high</u> values of P and not low ones. This is what creates a nonconcavity in $\hat{\pi}(\cdot)$ when goods are substitutes. This nonconcavity causes a discontinuity in the best response function and makes the unique equilibrium a mixed strategy one. However, since the peak of $\bar{\pi}(p)$, the profits of a Stackelberg leader, can be attained by the domestic firm by charging a high enough price, the domestic firm's profits must be at least those of a Stackelberg leader and in equilibrium can be shown to be equal to those of a Stackelberg leader.

The details of this analysis can be found in Krishna (1983). In equilibrium, all prices and profits are shown to rise when a VER at or close to the free trade level of imports is imposed. Some intuition for this comes from noticing that the relationship between $x(P_N, P_N^*)$ and $\bar{x}(P_N)$ with substitute goods remains the same as with complementary goods. This is because $G'(P) > 0$ and $x_{p*}(.) > 0$ so that $x_p(P_N, P_N^*) < \bar{x}_p(P_N)$ as before. However, the constraint now binds for high values of P given P*. Hence, the demand curve facing the domestic producer is given by BED in Figure 3(a) and becomes more inelastic for prices above P_N. This creates an incentive for the domestic firm to raise its price. This in turn shifts the foreign firms' demand function outward to BG in Figure 3(b), and makes it optimal for the foreign firm to also raise its prices to that corresponding to the point F in Figure 3(b). This is why all prices tend to rise, which tends to raise profits as well.

Returning to the effects of a VER with complementary goods, it is easy to verify that if best response functions are upward sloping, exactly analogous arguments show that there is no effect of a VER at free trade levels. In this case, $B^*(P)$ always lies to the right of $P^* = P_N^*$ so the Nash equilibrium profits also equal the profits when the domestic firm is a Stackelberg leader.

Now consider the effects of a tariff. A tariff on imports shifts the foreign firm's best response function outward to one such as $B^*(P,t)$ in Figure 1. This leads to an equilibrium at E. The line $P^* = G(P,t)$ depicts the set of prices which lead to the demand for imports being equal to their level under the tariff t. As $G(P,t)$ lies above $G(P)$, the level of imports falls. It is easy to verify, by using arguments analogous to those previously made, that if this level of imports is set as a VER, the equilibrium of the game remains at E. Thus, tariffs and VERs are equivalent with complementary goods. The only difference between them lies in the fact that no revenues are collected by the domestic government under a VER. However, tariffs and VERs are not equivalent when the goods are substitutes for one another. In this case VERs have effects by their very presence, even when they are not set at

Given that tariffs and quotas have different effects depending on whether goods are substitutes or complements, the natural question to ask is when one might expect to see lobbying in favor of VERs and by whom.

If goods are complements, a restrictive VER reduces foreign output, which reduces domestic profits. (This can be seen in Figure 1 as profits rise in the direction of the arrow so that domestic profits at E are lower than at A.) Intuitively this is because a reduction in the availability of the foreign good reduces the willingness to pay for the domestic one because of

their complementary nature. It is, therefore, unlikely that domestic firms would lobby for VERs. For the same reason, the domestic firm would not lobby for a tariff on imports. The foreign firm is also unlikely to desire VERs that are even moderately restrictive. It will not desire them if best response functions are upward sloping. However, if best response functions are downward sloping, slightly restrictive VERs would raise its profits. This is because the iso-profit contours are horizontal at A and a slight VER would move the equilibrium into the shaded area in Figure 1 where the foreign firm's profits rise. However, the increase in profits is likely to be marginal.

The incentives to lobby when goods are substitutes are completely different. In this case a VER serves as a precommitment device that facilitates collusion and all profits rise in a discrete manner when a VER at or close to free trade is imposed. Lobbying for VERs by both foreign and domestic firms is to be expected in this case. Tariffs on the other hand, improve the competitive position of domestic firms and raise their profits, but reduce those of the foreign firm. This is because the tariff tends to raise the foreign price when goods are substitutes. This acts to raise domestic profits along the domestic best response function -- and reduce foreign profits. Here, a domestic firm will lobby for a tariff and a foreign one will oppose it -- which is the usual presumption.

5. Conclusion

The results of the preceding analysis suggest that we should see efforts to lobby for VERs when substitution possibilities between products in making the services are large compared to the elasticity of demand for services -- i.e., when goods are substitutes in demand. We should not see such efforts when they are complements. Thus, if domestic producers made only speakers and foreign ones made only amplifiers, one would not expect to see lobbies for VERS on amplifiers. However, if both made complete systems and only sold them as a unit, one would expect to see such lobbies. Moreover, the results imply that tariffs and quotas are equivalent when goods are complements -- even with oligopoly. However, they are fundamentally non-equivalent when goods are substitutes.

The paper suggests that large price increases should be associated with the imposition of a VER with substitute goods, but not with complementary goods. This is so even when the VER is set at a level close to the free trade one. While a VER does give the domestic firm the profits of a Stackelberg leader when goods are substitutes, and a particular rationing rule is employed, it does not necessarily do so when they are complements and it is inappropriate to assume that a VER makes the domestic firm into a Stackelberg leader.

Finally, the profusion of models used to study the effects of VERs and the variety of results yielded by them make further work on the empirical side highly desirable.

Footnotes

1. See Cline (1983), p. 4.

2. See Tumlir (1985), p. 2.

3. See Tumlir (1985), p. 42.

4. In Gelman and Salop (1983) capacity choice plays the same role a VER plays here. However, it can be prohibitively expensive for the foreign firm to constrain capacity if it sells in other markets as well. A VER then operates as a selective capacity constraint.

5. This is necessarily a brief review of the work in the area. More detailed references can be found in the papers cited.

6. Recent work by Kreps and Schienkman (1985) also relates price and quantity competition models by showing that the Cournot outcome arises as the equilibrium of a two stage game, where firms first choose capacities and then compete in price, given capacities.

7. See Feenstra (1984).

8. See Krishna and Itoh (1988) for a proof.

9. See Sonnenschein (1968) and Singh and Vives (1984) on the relation between Bertrand and Cournot Nash equilibrium with substitutes and complements being produced.

10. The unconvinced reader should draw a concave $\pi^*(P,P^*)$ for a given P and verify that the VER alters $\pi^*(P,P^*)$ by creating a linear segment for low P^*. The resulting kink in π^* is what makes it optimal to price at G(P).

References

Aw, B.Y. and Roberts, M.J. (1986), "Measuring Quality Change in Quota. Constrained Import Markets: The Case of U.S. Footwear," Journal of International Economics, vol. 21, no. 1/2, August, pp. 45-60.

Bhagwati, J.N. (1965), "On the Equivalence of Tariffs and Quotas," in R.E. Baldwin et al., eds., Trade, Growth and the Balance of Payments. Essays in Honor of Gottfried Haberer (Chicago: Rand McNally).

Cline, W.R. (1983), "Introduction and Summary," Ch.1 in Cline, W.R., ed., Trade Policy in the 1980's.

Das, S.P. and Donnenfeld, S. (1984), "Rent and Quality Seeking: The Role of Trade Policies," mimeo.

Das, S.P. and Donnenfeld, S. (1985), "Trade Policy and Its Impact on Quality of Imports," mimeo.

Davidson, C. (1984), "Cartel Stability and Tariff Policy," Journal of International Economics, 17, pp. 219-237.

Dixit, A. (1986), "Optimal Trade and Industrial Policies for the U.S. Automobile Industry," mimeo.

Eaton, J. and Grossman, G. (1986), "Optimal Trade and Industrial Policy Under Oligopoly," Quarterly Journal of Economics, vol. CI, issue 2, May.

Falvey, R. (1979), "The Composition of Trade Within Import Restricted Categories," Journal of Political Economy, vol. 87, no. 5, pp. 1105-1114.

Feenstra, R. (1984), "Voluntary Export Restraint in U.S. Autos, 1980-81: Quality Employment and Welfare Effects," in Robert Baldwin and Ann Krueger, eds., The Structure and Evolution of Recent U.S. Trade Policy, Chicago: University of Chicago Press.

Feenstra, R. (1985), "Quality Change Under Trade Restraints: Theory and Evidence from Japanese Autos," Discussion Paper No. 298, Columbia University.

Feenstra, R. (1987), "Automobile Prices and Protection: The U.S.-Japan Trade Retraint," chapter 15 in Dominick Salvatore, ed., "The New Protectionist Threat to World Welfare," New York-London-Amsterdam: North Holland.

Gelman, J. and Salop, S. (1983), "Judo Economics: Capacity Limitation and Coupon Competition," Bell Journal of Economics, Vol. 14, No. 2.

Harris, R. (1985), "Why Voluntary Export Restraints are Voluntary," Canadian Journal of Economics XVIII, no. 4, November, pp. 799-809.

Itoh, M. and Ono, Y. (1982), "Tariffs, Quotas, and Market Structure," Quarterly Journal of Economics, vol. XCVII, May, pp. 295-305.

Itoh, M. and Ono, Y. (1984), "Tariffs vs. Quotas Under Duopoly of Heterogeneous Goods," Journal of International Economics, vol. 17. no. 3/4, November, pp. 359-374.

Krepps, D. and Schienkman, J. (1985), "Quantity Precommitment and Bertrand Competition Yield Cournot Outcomes," Bell Journal of Economics 14, Autumn, pp. 326-337.

Krishna, K. (1983), "Trade Restrictions as Facilitating Practices," Woodrow Wilson School, Princeton University, discussion paper #55. Also, NBER Working Paper No. 1546.

Krishna, K. (1984), "Protection and the Product Line," NBER Working Paper

No. 1537.

Krishna, K. (1987), "Tariffs vs. Quotas with Endogenous Quality," Journal of International Economics, 23, pp.97-122.

Krishna, K. and Itoh, M. (1988), "Content Production and Oligopolistic Interaction," Review of Economic Studies, vol. LV(1) no. 181, January, pp. 107-25.

Lambson, V. and Richardson, J.D. (1986), "Tacit Collusion and Voluntary Restraint Agreements in the U.S. Auto Market," (Mimeo) Paper presented at NBER Conference on Empirical Studies of Strategic Trade Policy.

Levinsohn, J. (1987), "Empirics of Taxes on Differentiated Products: The Case of Tariffs in the U.S. Automobile Industry." University of Michigan, Discussion Paper No. 208.

Rodriguez, Carlos Alfredo (1979), "The Quality of Imports and the Differential Welfare Effects of Tariffs, Quotas, and Quality Controls as Protective Devices," Canadian Journal of Economics, vol. 12, no. 3, pp. 439-449.

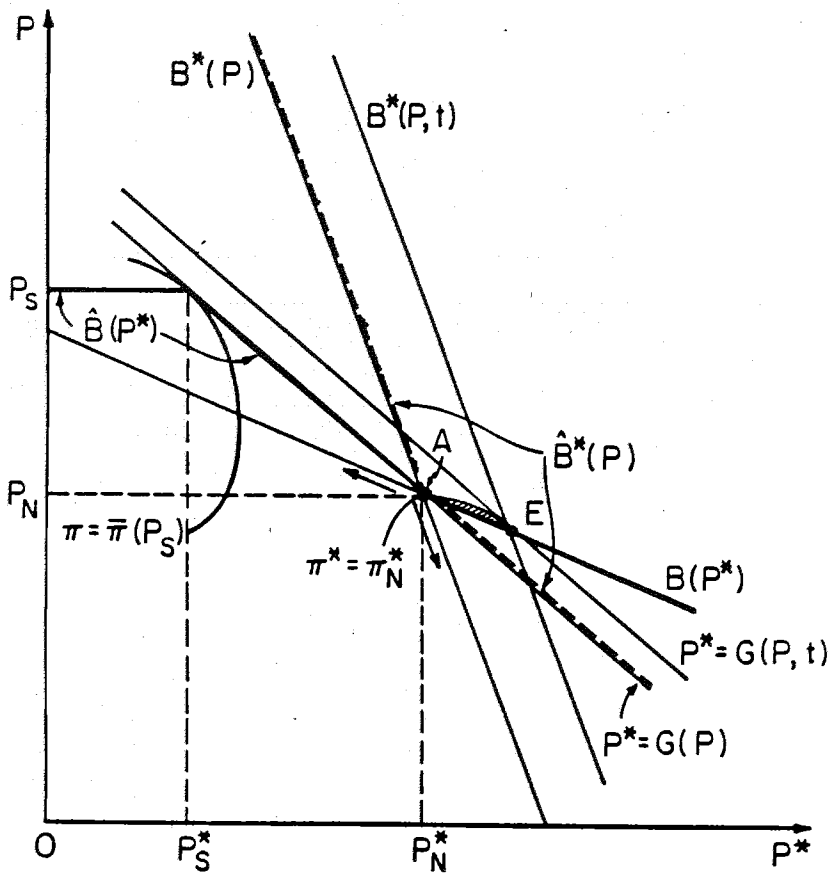
Rotemberg, J. and Saloner, G. (1986), "Quotas and the Stability of Implicit Collusion," NBER Working Paper No. 1948.

Santoni, G.J. and Van Cott, T.N. (1980), "Import Quotas: The Quality Adjustment Problem," Southern Economic Journal, vol. 46, no. 4, pp. 1206-1211.

Singh, N. and Vives, X., (1984), "Price and Quantity in a Differentiated Duopoly," Rand Journal of Economics, Winter, 15(4), pp. 546-54.

Sonnenschien, H. (1968), "The Dual of Duopoly is Complementary Monopoly or Two of Cournot's Theories are One," Journal of Political Economy 76, pp. 316-318.

Tumlir, J., "Protectionism (1985) Trade Policy in Democratic Societies," American Enterprise Institute for Public Policy Research, Washington, D.C.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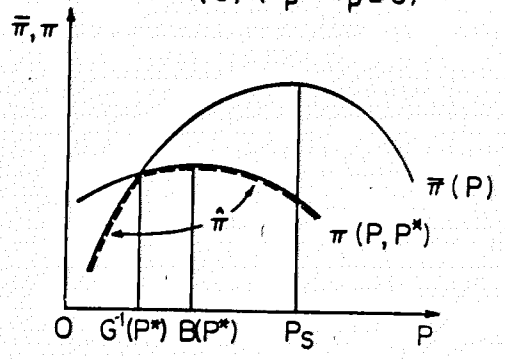
(a) $(\bar{\pi}_P > \pi_P \geq 0)$



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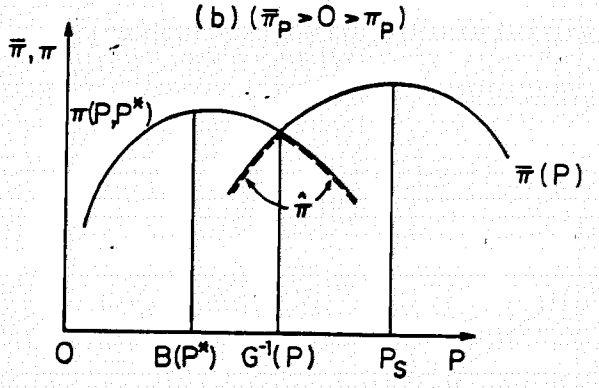
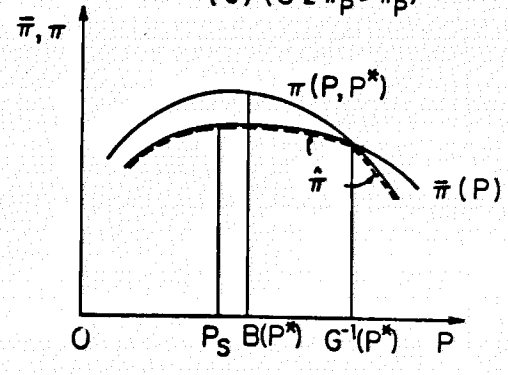


(c) $(0 \geq \bar{\pi}_P > \pi_P)$



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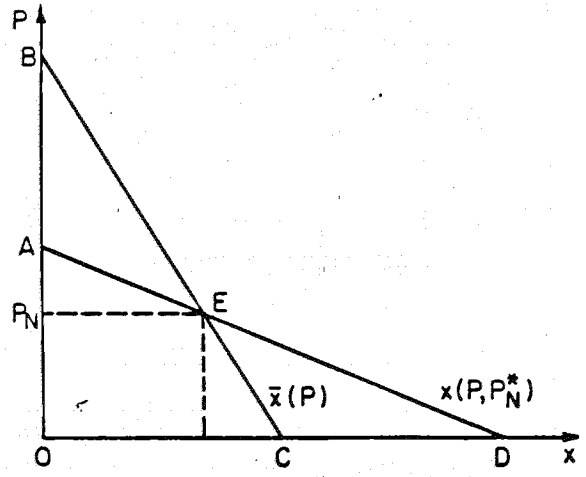

(b)